RAMAKRISHNA MISSION VIDYAMANDIRA

NEP Syllabus B.Sc. Computer Science Honours

Semester-IV

Course Code: 4CMSMJC4

Course Type: Major Course

Course Outcome:

- Recognizing and recalling basic definitions of set, relation, permutation, combination, probability and key terms such as graph, vertex, edge, degree, path, and cycle.
- Understanding and describing properties of sets (such as subset, power set, and Cartesian product), equivalence relation, poset, Hasse diagram, group, combinatorial principles like the Pigeonhole Principle or Inclusion-Exclusion Principle, different types of graphs (such as complete, regular, bipartite, Euler, Hamiltonian graphs) and interpreting the fundamental rules of probability and probability distribution functions.
- Apply theoretical knowledge to solve problems involving sets, functions, combinatorics and graphs.
- Analyzing problems to determine the appropriate use of Binomial distribution, Poisson distribution, Normal distribution and examining graph properties like connectivity, planarity, or containing any Eulerian path or Hamiltonian cycles.
- Verifying solutions to combinatorial and probabilistic problems for correctness.
- Constructing proofs for mathematical statements and creating new models to represent complex systems using graph theory.
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4CMSMJC4: Computational Mathematics

Credit: 3 **Marks: 50**

Introduction to Set Theory: Sets - finite and infinite sets, uncountable Infinite sets, set algebra; functions, relations, equivalence relations and partitions, composition of relations, closure of relations, Warshall's algorithm, Partial Ordering Relations, Poset, Hasse Diagram, Lattice, introduction to Boolean algebra. **[8 L]**

Group Theory: Definition and properties of group, groupoid, semigroup, monoid, subgroup, cyclic group, cosets and related theorems. Concept of permutation group, Ring and Field.

[8L]

Counting Theory: Pigeon Hole Principle (generalized statement, proof and standard applications to mathematical problems), Principle of Inclusion and Exclusion (generalized statement, proof and standard applications to mathematical problems), Permutations and Combinations (with and without repetition). **[3 L]**

Introduction to Probability and Statistics: Definition of sample space, events, probability, simple problems, theorems on Total Probability, Conditional Probability, Bayes' Theorem; Random variable, Expectation, Variance, Standard Deviation, Bernoulli Trials, Probability distributions – Binomial Distribution, Poisson Distribution, Normal Distribution (definition, mean and problems). **[9L]**

Introduction to Graph Theory:
Definition of graph, self-loop, parallel edges, simple graph, multi graph, pseudo graph, directed graph, weighted graph, complete graph, regular graph, bipartite graph, complete bipartite graph. Application of graphs, concept of finite and infinite graph, size and order of a graph, isolated vertex, pendant vertex and null graph. Operation on graphs (Union, Intersection, Ring sum, Decomposition, Deletion of edge and vertex, Fusion). **[6L]**

Walk, Path and Circuit: Walk, path, circuit and their differences, connected and disconnected Graph, components, strongly and weakly connected graph, subgraphs, graph isomorphism, Euler Graph, arbitrarily traceable graph, Hamiltonian path and circuit.

[4L]

Cut Set and Cut Vertices: Cut set and its properties, All Cut-sets in a graph, Fundamental circuit and Cut set, Connectivity (Edge and Vertex), Separability. **[2L]**

Planar Graph: Euler formula, Kuratowski's theorem, Geometric Dual. **[2L]**

Computer Representation of a Graph: Definition and application of Adjacency Matrix, Incidence Matrix and Circuit Matrix. **[3L]**

Computational Mathematics Tutorial

Credit: 1 **Marks: 25**

Some real-time problems incorporating the application power and knowledge on Sets, Functions, Relations, Counting theory, Recurrence relations, graphs, Probability, Binomial Distribution, Poison Distribution and Normal Distributions.
[10L]

Introduction to R for performing the set operations, exploring the combinatorial problems and analyzing the properties of graphs. [5L]

Recommended Books:

1. Discrete Mathematics and its applications by Rosen, Tata McGraw Hill.
2. Elements Of Discrete Mathematics by C. L. Liu and D.P. Mohapatra, TMH.
3. Textbook Of Discrete Mathematics by Swapan Kumar Sarkar, S Chand.
4. Essentials of Discrete Mathematics by D.J. Hunter, Jones and Bartlett Publishers.
5. A First Course in Probability by Sheldon Ross, Pearson.
6. Probability & Statistics for Engineers & Scientists by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall.
7. An Outline of Statistical Theory Vol.1 by A.M.Gun, M.K.Gupta and B.Dasgupta, World Press Pvt. Ltd.
8. Graph Theory With Applications To Engineering And Computer Science by Narsingh Deo, PHI.
9. Graph Theory by J.A. Bondy and U.S.R. Murty, Springer.
10. Introduction to Graph Theory by D. B. West, 2nd edition, Pearson Education.
11. Graph Theory With Applications To Engineering And Computer Science by Narsingh Deo, PHI.
12. Graph Theory by J.A. Bondy and U.S.R. Murty, Springer.
13. Introduction to Graph Theory by D B West, 2nd edition, Pearson Education.